# ADAPTIVE MODULE FOR HOUSINGS

## TECHNICAL FIELD

**[0001]** The present invention relates generally to the field of housings for electronics and, in particular, to an adaptive module for housings.

## BACKGROUND

**[0002]** A common method for improving system reliability involves redundancy. This typically involves having active system components and backup system components that duplicate the active system components. The purpose of the backup system components is to take over for the active system components in the event that the active system components fail. In many electronic systems, such as cable modem termination systems (CMTSs), this involves switching from the active system components to the backup system components when the active system components fail.

**[0003]** In the example of cable modem termination systems, many cable modem termination systems include a number of electronic modules that are contained within housings and are plugged into backplanes within the housings. To provide redundancy, some of the electronic modules are used as backup modules. This is typically accomplished using additional components, e.g., for connecting the electronic modules to function as backups, switching to the backup modules, etc. However, this usually requires designing and manufacturing a separate line of larger housings for accommodating the additional components. Moreover, it is often desirable to upgrade non-redundant systems to redundant systems in the field. One problem with this is that the housings for many non-redundant systems are too small to accommodate the additional components. Therefore, the non-redundant system, including the housing, needs to be replaced with a redundant system in a larger housing. Some manufacturers provide for upgrades by housing the non-redundant systems in housings large enough to accommodate the additional components and include the additional components. However, many customers do not require such upgrades and end up paying for larger housings and for additional components that are not needed, as well as higher shipping costs for shipping the larger housings and additional components.

[0004] For the reasons stated above, and for other reasons stated below that will become apparent to those skilled in the art upon reading and understanding the present specification, there is a need in the art for mitigating the problems associated with adding additional components to electronic systems, such as cable modem termination systems, for making these systems redundant.

## SUMMARY

[0005] The above-mentioned problems with adding additional components to electronic systems to make these systems redundant and other problems are addressed by embodiments of the present invention and will be understood by reading and studying the following specification. Embodiments of the present invention provide an adaptive module for modifying existing housings for containing non-redundant electronic systems, such as the existing housings for non-redundant cable modem termination systems, to add redundancy to the electronic systems. This enables existing non-redundant electronic systems to be upgraded in the field to redundant systems without having to replace the existing housing. Moreover, this eliminates the need for designing and manufacturing a new line of housings for housing redundant systems.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1 is an exploded perspective view of a housing according to the teachings of the present invention.

[0007] Figure 2 is an exploded side view of the housing of Figure 1.

## DETAILED DESCRIPTION

[0008] In the following detailed description, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific illustrative embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that logical, mechanical and electrical changes may be made without departing from the

spirit and scope of the present invention. The following detailed description is, therefore, not to be taken in a limiting sense.

**[0009]** Figures 1 and 2 illustrate an embodiment of a housing 100 for an electronic system, such as a cable modem termination system, according to the teachings of the present invention. Figure 1 is an exploded perspective view, and Figure 2 is an exploded side view. Housing 100 includes a base module 102 and an adaptive module 104. In one embodiment, base module 102 is a basic housing for a non-redundant electronic system, such as a cable modem termination system, e.g., a non-redundant CUDA 12000 cable modem termination system commercially available from ADC Telecommunications of Eden Prairie, MN. In another embodiment, adaptive module 104 is added to base module 102 to add redundancy to the electronic system.

**[0010]** In one embodiment, adaptive module 104 is added to a basic housing of a non-redundant cable modem termination system to upgrade the non-redundant cable modem termination system without having to change the basic housing of the non-redundant system. In other embodiments, adaptive module 104 is added to the basic housing of non-redundant cable modem termination systems during manufacturing, enabling redundant cable modem termination systems to be manufactured from the existing basic housings. This eliminates the need for designing and manufacturing a new line of housings for housing redundant systems.

**[0011]** Base module 102 is adapted to house a number of primary electronic modules adapted to transmit and receive signals, e.g., primary electronic modules $108_1$ and $108_2$ of the electronic system. More particularly, base module 102 includes a card cage 116 having slots 117 for receiving primary electronic modules $108_1$ and $108_2$. A backplane 118 is secured within card cage 116 adjacent to an end 120 of card cage 116 using fasteners, such as screws, bolts or the like. Each of primary electronic modules $108_1$ and $108_2$ plugs into backplane 118. For example, connectors 122 and 124 of primary electronic module $108_1$ respectively connect to connectors 126 and 128 of backplane 118, as shown in Figure 2. In one embodiment, base module 102 of housing

100 includes plenums 146 for providing directed airflow for cooling the electronic system.

**[0012]** Adaptive module 104 has a backplane 110. In one embodiment, backplane 110 is secured to card cage 116 adjacent to end 120 of card cage 116 so that backplane 110 is spaced from backplane 118 and is parallel to backplane 118. In another embodiment, a cover 130 is disposed between backplane 110 and backplane 118. A card cage 132 of adaptive module 104 is secured to card cage 116 adjacent to end 120 using fasteners, such as screws, bolts, or the like. A number of secondary electronic modules adapted to transmit and receive signals, e.g., secondary electronic modules $112_1$ and $112_2$, are disposed in slots 134 of card cage 132. Each of secondary electronic modules $112_1$ and $112_2$ respectively connects to each of primary electronic modules $108_1$ and $108_2$. In various embodiments, each of secondary electronic modules $112_1$ and $112_2$ respectively receives signals from and/or transmits signals to each of primary electronic modules $108_1$ and $108_2$

**[0013]** More specifically, connector 136 of secondary electronic module $112_1$ connects to connector 138 of primary electronic module $108_1$, as illustrated in Figure 2. Each of secondary electronic modules $112_1$ and $112_2$ also connect to backplane 110, e.g., connector 140 of secondary electronic module $112_1$ connects to connector 142 of backplane 110. Circuit boards of a switch/relay 114 are disposed in slots 143 of card cage 132. Switch/relay 114 connects to connector 144 of backplane 110. Secondary electronic module $112_1$ includes a number of connectors 148 for connecting the electronic system to remote equipment, such as modems or the like. In one embodiment, connectors 148 transmit signals to remote equipment and receive signals from the remote equipment.

**[0014]** In one embodiment, secondary electronic modules $112_1$ and $112_2$ are respectively active and backup secondary electronic modules, and primary electronic modules $108_1$ and $108_2$ are identical. Connecting secondary electronic module $112_2$ to primary electronic module $108_2$ and to backplane 110 connects primary electronic module $108_2$ as a backup to primary electronic module $108_1$. Switch/relay 114 switches

operation from primary electronic module $108_1$ to primary electronic module $108_2$ in the event a failure occurs within primary electronic module $108_1$. In this way, adaptive module 104 adds redundancy to an otherwise non-redundant electronic system.

**[0015]** During operation, secondary electronic module $112_1$ receives first signals from primary electronic module $108_1$, designated as an active electronic module, and transmits a first portion of the first signals to backplane 110 and a second portion to connectors 148. Backplane 110 transmits the first portion of the first signals to switch/relay 114. If the first signals are okay, e.g., no failures within primary electronic module $108_1$, the first portion of the first signals are terminated at switch/relay 114 and the second portion of the first signals are transmitted to remote equipment via connectors 148. Second signals are also received at secondary electronic module $112_1$ via connectors 148 from the remote equipment. Secondary electronic module $112_1$ transmits a first portion of the second signals to connector 136 and a second portion of the second signals to backplane 110. Backplane 110 transmits the second portion to switch/relay 114, where the second portion is terminated. Connector 136 transmits the first portion of the second signals to primary electronic module $108_1$.

**[0016]** In the event of a failure within primary electronic module $108_1$, e.g., the first signals received at switch/relay 114 are bad, switch/relay 114 switches to a backup mode. In the backup mode, secondary electronic module $112_2$ receives the first signals from primary electronic module $108_2$, designated as a backup electronic module. These first signals are the same first signals that secondary electronic module $112_1$ received from primary electronic module $108_1$ prior to the failure. Secondary electronic module $112_2$ transmits the first signals to backplane 110. Backplane 110 transmits the first signals to switch/relay 114. If the first signals are okay, e.g., no failures, switch/relay 114 transmits the first signals back to backplane 110. Backplane 110 transmits the first signals to secondary electronic module $112_1$, which outputs the first signals at connectors 148. In switching to the backup mode, switch/relay 114 enables the first signals to be routed from secondary electronic module $112_2$ to connectors 148. In the

backup mode, secondary electronic module $112_1$ provides an interface between primary electronic module $108_2$ and remote equipment.

**[0017]** During backup mode operation, the second signals received at connectors 148 from the remote equipment are conveyed from secondary electronic module $112_1$ to backplane 110. Backplane 110 transmits the second signals to switch/relay 114, which sends the second signals back to backplane 110. Backplane 110 transmits the second signals to secondary electronic module $112_2$. Secondary electronic module $112_2$ transmits the second signals to primary electronic module $108_2$. In switching to the backup mode, switch/relay 114 also enables the second signals to be routed from connectors 148 to secondary electronic module $112_2$.

**[0018]** In one embodiment, primary electronic modules 108, secondary modules 112, and switch/relay 114 are respectively the CMTS transceivers, interface adapters, and switch module of United States Patent Application Serial No. _____ (Attorney Docket No. 100.361US01) filed November 26, 2001, commonly assigned, which application is incorporated herein by reference.

## Conclusion

**[0019]** Embodiments of the present invention have been described. The embodiments provide an adaptive module for modifying existing housings for containing non-redundant electronic systems, such as the existing housings for non-redundant cable modem termination systems, to add redundancy to the electronic systems. This enables existing non-redundant electronic systems to be upgraded in the field to redundant systems without having to replace the existing housing. Moreover, this eliminates the need for designing and manufacturing a new line of housings for housing redundant systems.

**[0020]** Although specific embodiments have been illustrated and described in this specification, it will be appreciated by those of ordinary skill in the art that any arrangement that is calculated to achieve the same purpose may be substituted for the specific embodiment shown. This application is intended to cover any adaptations or

variations of the present invention. For example, backplane 110 can be secured within card cage 132 instead of being secured to card cage 116.